CLAIMS:

1. A method for etching a solid state material to create a surface relief pattern, the method comprising steps of:

forming a photoresist layer on the surface of the solid state material;

holographically patterning the photoresist layer to form a patterned mask;

transferring the pattern in the patterned mask into the solid state material by dry etching.

2. The method of claim 1, wherein the photoresist comprises SU-8.

3. The method of claim 1, wherein said step of forming comprises spin coating the photoresist layer.

4. The method of claim 1, wherein further comprising a step of, subsequent to said step of holographically patterning, optically direct writing a defect into the patterned mask.

5. The method of claim 4, wherein said step of holographically patterning comprises:

conducting a first volumetric interfering of at least two beams; and

after changing the position of the solid state material and the photoresist layer, conducting a second volumetric interfering of at least two beams.

6. The method of claim 4, wherein said step of holographically patterning comprises changing the angle between two interfering beams used in the holographically patterning to introduce a period change in the periodic pattern.

7. The method of claim 4, wherein said step of holographically patterning comprises changing the exposure time during the holographically patterning to introduce a duty cycle change in the periodic pattern.

8. The method of claim 4, further comprising steps of:

post-exposure baking the photoresist layer exposed by said steps of holographically patterning and optically direct writing; and

developing the photoresist layer form the patterned mask.

9. The method of claim 8, comprising optimizing said steps of holographically patterning and post-exposure baking to increase aspect ratios of the mask pattern transferred into the photoresist layer and to increase the quality of the geometric shape of the mask pattern.

10. The method of claim 9, wherein optimizing said step of holographically patterning comprises adjusting exposure power per unit surface area.

11. The method of claim 9, wherein optimizing said step of holographically patterning comprises determining an optimal exposure time.

12. The method of claim 8, further comprising preliminary soft baking, performed immediately prior to said step of holographic patterning.

13. The method of claim 8, performed to create a sub-wavelength optical structure.

14. The method of claim 8, performed to create an optical grating having sub-wavelength spacing between grating elements.

15. The method of claim 8, wherein the exposure power in said step of holographic recording is in the range of 35 to 90mJ/cm^2.

16. The method of claim 1, performed to create a sub-wavelength optical structure.

17. The method of claim 1, performed to create an optical grating having sub-wavelength spacing between grating elements.

18. The method of claim 1, wherein the solid state material comprises a semiconductor quality Group III-V material layer.

19. The method of claim 1, wherein the solid state material comprises GaAs.

20. A spectral filter, comprising:

a substrate (27);

a multi-layer structure (28) having layers (30, 32) with alternating refractive indices;

nanocavities (26) etched into the multi-layer structure; and

periodic defects (34) in the multi-layer structure periodically interrupting the alternating refractive indices.

21. A method for forming a photonic lattice pattern in a semi-conductor crystal:

forming a photoresist layer on the semi-conductor crystal;

exposing the photoresist layer by volumetric interference of at least two beams that create an interference pattern in the photoresist layer to expose a photonic lattice pattern;

creating at least one defect in the photonic lattice pattern by optical direct writing;

developing the photoresist layer to form a mask; and

dry etching to pattern the semiconductor material and remove the mask.

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